QUANTITATIVE ANALYSIS OF OSTEOMA CUTIS*

ROBERT E. ROSSMAN, M.D., MATTHEW W. NOALL, Ph.D. AND
ROBERT G. FREEMAN, M.D.

The transformation of epithelial or connective tissue into nodules or spicules with the morphologic appearance of normal bone is not infrequently observed; and it has been suggested that the resulting structures are true bone. Qualitative chemical analyses from such cases have yielded variable results; and there appear to be no reports of quantitative analyses. Histochemical reactions and chemical analysis suggest the nodules are pre-osseous tissue rather than mature bone. Reliance on gross morphologic appearance alone may be misleading.

Material from a biopsy specimen obtained from the face of a 62 year old woman revealed the histologic structure of osteoma cutis. The nodules were periodic acid-Schiff positive, diastase resistant, and stained brown with the Von Kossa technic. Clinical aspects of the case will be reported in detail elsewhere.

CHEMICAL ANALYSIS

Two specimens were subjected to quantitative analysis with the following results:

Wet Weight	20.17 mg
Dry Weight	11.08 mg
Water Loss	9.09 mg
Percentage Water	45.2
Calcium Content (as Ca)	1.66 mg
Phosphorous Content (as P)	0.141 mg

Bubbling did not occur when the tissue was treated with nitric acid suggesting that carbonates were not a major constituent. The Ca/P ratio was 11.7, Ca content was 15% and P content 1.3% on a dry weight basis. The main inorganic component of bone is hydroxyapatite $(Ca_3PO_4)_3 \cdot Ca(OH)_2$. It contains 39.8% Ca and 18.5% P. Regardless of variations in total mineral content the Ca/P ratio should approximate 2.15 (1, 2).

COMMENT

Osteogenesis has been attempted experimentally utilizing many technics in several animal species. A summary of available information is well presented in a recent paper by Makin (3). He demonstrated the rapid induction of osseous-like material in vesical mucosa transplanted to the paraspinal muscle of guinea pigs. The mechanism proposed differs from the two classic types of osteogenesis, enchondral and membranous, in that hyaloid islands formed by epithelial secretions become the bone precursor.

Clinical examples of soft tissue ossification are well known. Lehrman, Pratt and Parkhill (4) noted heterotopic bone developing post-operatively in laparotomy scars, particularly of the upper or lower midline. Metaplastic osseous nodules have occurred in the skin secondary to severe acne, late syphilis, benign and malignant tumors, and other chronic dermatoses (5). Selye (6) states that in many cases these may be variants of cutaneous calcinosis. Although closely resembling bone, and in some instances having associated hemopoetic tissue, they rarely advance beyond a pre-osseous stage.

The finding of periodic acid-Schiff positive staining and a Ca/P ratio of 11.7 support the interpretation that heterotopic osseous tissue is not true bone but a pre-osseous tissue with a morphology resembling bone in certain aspects. Quantitative studies of heterotopic bone from other sites may help to clarify this point and to better understand the pathogenesis of this disorder.

SUMMARY

Quantitative analysis of two lesions from a patient with osteoma cutis revealed a Ca/P ratio of 11.7 in contrast to a ratio of 2.15 for true bone. The osseous nodules were PAS positive. These findings suggest the material is not true bone but a pre-osseous type of tissue.

REFERENCES

1. ANNINO, JOSEPH S.: Clinical Chemistry; Principles and Procedures, 2nd ed., Boston, Little Brown & Co., 1960.
2. REIFENSTEIN, JR., E.: Metabolic Disorders of Bone, In Principles of Internal Medicine, 4th ed., p. 692. Editors T. R. Harrison (and others). New York, Blakiston Division, McGraw Hill, 1962.
3. MAKIN, M.: Osteogenesis induced by vesical mucosal transplant in the guinea pig. J. Bone Surg., **44-B:** 165, 1963.
4. LEHRMAN, A., PRATT, J. AND PARKHILL, E.: Heterotopic bone in laparotomy scars. Amer. J. Surg., **104:** 591, 1962.
5. SUTTON, R.: Diseases of the Skin, 11th ed., p. 1138. St. Louis, The C. V. Mosby Co., 1956.
6. SELYE, H.: Calciphylaxis, Chicago, The University of Chicago Press, 1962.

* From the Departments of Dermatology and Pathology, Baylor University College of Medicine, Houston, Texas.

Received for publication April 19, 1963.